

NASA-Delta Air Lines Technical Interchange

DIP
DIGITAL INFORMATION PLATFORM

January 24th, 2023

SWIM

Weather

Agenda

Time	Topic
8:45 am	NASA visitors arrive
9:00 am – 9:30 am	Delta Ops Meeting
9:30 am – 9:40 am	Introduction
9:40 am – 10:20 am	Delta Operations Control Center (OCC) Tour
10:20 am – 11:50 am	DIP Overview
11:50 am – 12:20 pm	Working lunch
12:20 pm – 1:10 pm	DIP Team with Dispatch
1:10 pm – 2:00 pm	DIP Team with SPT (ATC Coordinators)
2:00 pm – 3:00 pm	DIP Team with Data Team
3:00 pm – 3:30 pm	Place holder
3:30 pm – 4:00 pm	Wrap up and next step (with ATM)



DIP Overview

Mirna Johnson

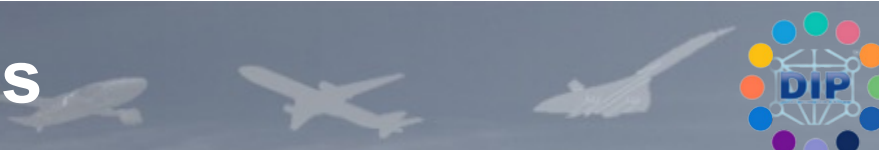
Digital Information Platform

*Accelerate NAS transformation with advanced, **data-driven, digital services** to promote **efficient aviation operations***

Cloud-based ecosystem that takes data from many sources and turns it into easily accessible, easy-to-use digital information to expand the development of reusable aviation services



Stakeholder Needs



Increase Access to NAS Information

Easy access to organized airspace data and information
Common, simplified API to fused information

Improved Data Quality

Trusted and **reliable** data sources with safeguards
Unified, aggregated, and **validated data** for consumption

High Reuse Solutions

Support **data-driven predictive** models
Scalable and **adaptable** services

Commercialization Methodology

Architecture that **connects high reuse solutions** for exchange of services and information to create an ecosystem

Services for Efficiency and Sustainability

Advanced services to increase efficiency and predictability
Digital Re-route, disruption management, trajectory optimization, etc

Sept – Nov 2019 - collected formulative input from **airline operators, airport operators, NBAA, FAA and vendor groups.**

March 2021 - **DIP** published a **Request for Information**; Received over 40 responses from flight operators, service providers, data integrators from traditional and emerging operations stakeholders



Digital Information Platform for Sustainability Services



Current Limitations

Segmented ATM Systems

Inconsistent Data Quality

Limited Paths to Enter Market

Demand for Sustainability

Problem Statement:

Hard to access and decipher data to provide advanced digital services for digital NAS transformation

Pursued Solution:

Pave the way for improving data accessibility to enable high-reuse digital service solutions that can scale and be more quickly discovered on a platform



Digital Services

Building blocks for reuse



Data Integration

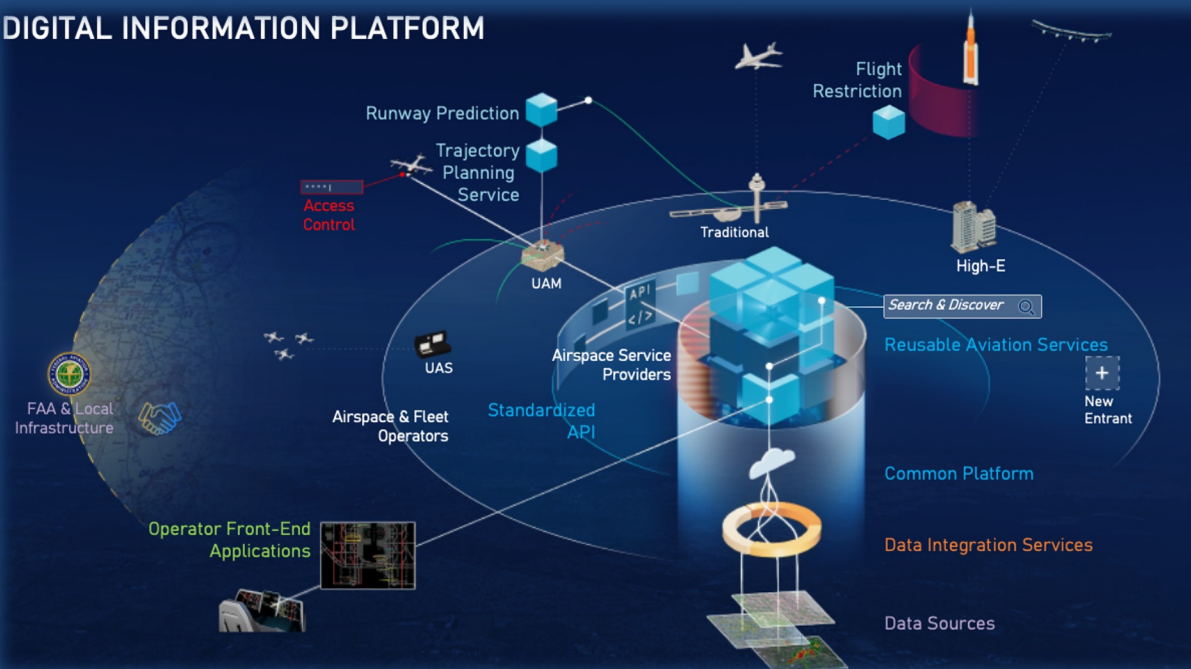
Combine and simplify data for holistic information



Common Platform

Cloud-based (smaller) footprint and standard APIs for simpler integration

DIGITAL INFORMATION PLATFORM



Advanced Technologies

Apply ML/AI to improve adaptability and extensibility of services



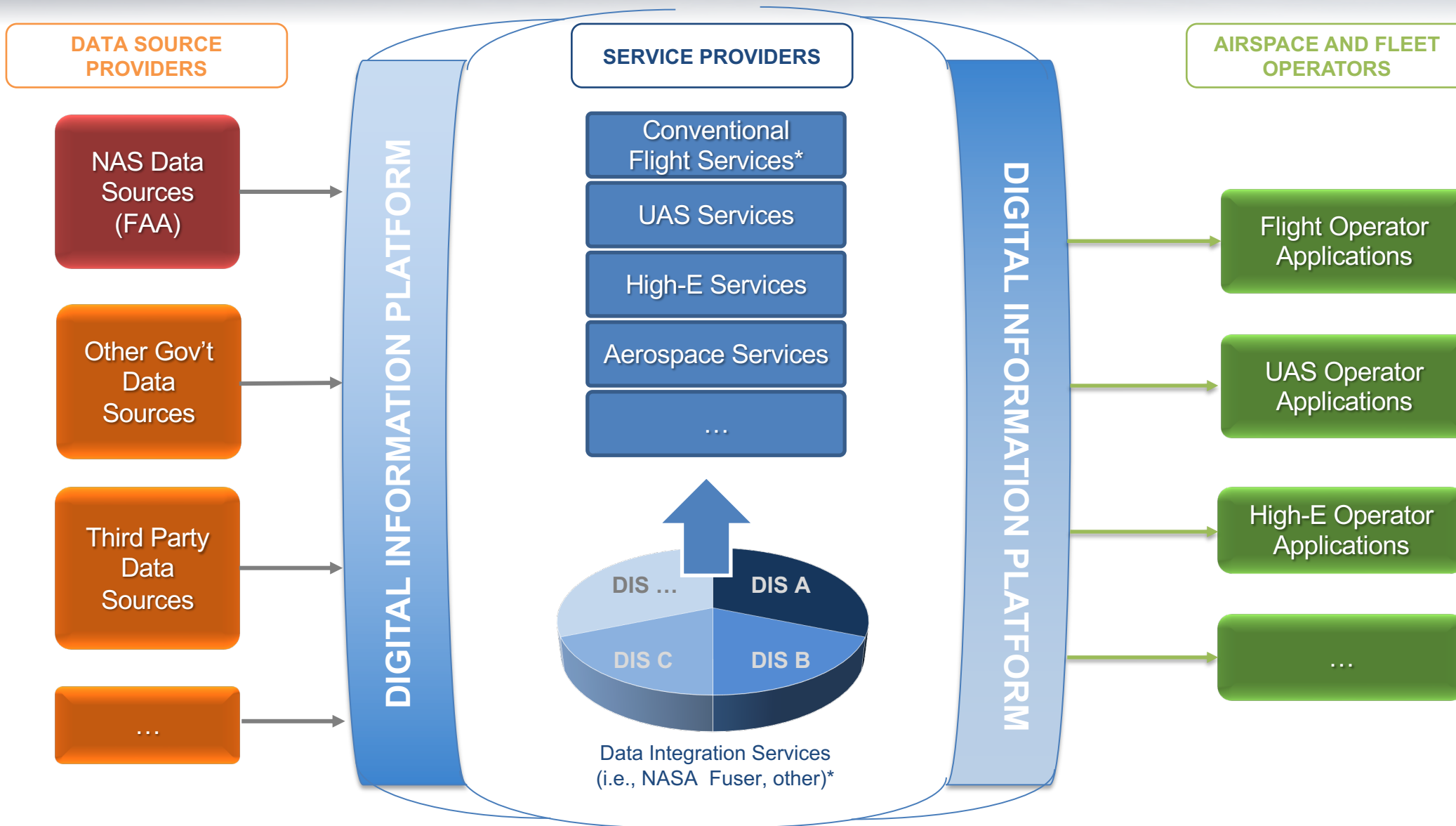
Performance Monitoring

Promote quality and build trust in information



Sustainability

Inform decision making to optimize efficiency



NASA Led DIP-Enabled Services for Sustainability



“SFNP-Ops Demos”

Ground and flight deck services focused on improving the sustainability of aviation operations

Industry Led Partner Service Evaluations



“PS Evals”

Integration and demonstration of Partner services with DIP for validation of the platform

University Challenges



Development of innovative solutions and advanced algorithms for aviation services

Reference Digital Information Platform (DIP)



Development of a platform for advanced, data-driven, digital services for flight operators and service consumers

DIGITAL INFORMATION PLATFORM

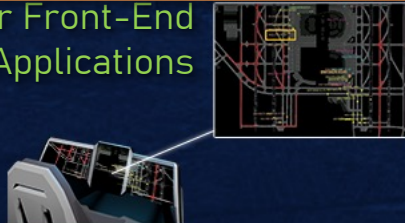
SFNP-Ops Demos: Demonstrates DIP enabled services for flight and airspace management in operational environments

FAA & Local
Infrastructure



PS Evals: Demonstrate an ecosystem of reusable aviation services enabled by DIP

Operator Front-End
Applications



Access
Control

Runway Prediction

Trajectory
Planning
Service

UAM

UAS

Standardized
API

Conventional

Flight
Restriction

High-E

Search & Discover

Reusable Aviation Services

New
Entrant

Common Platform

Data Integration Services

Data Sources

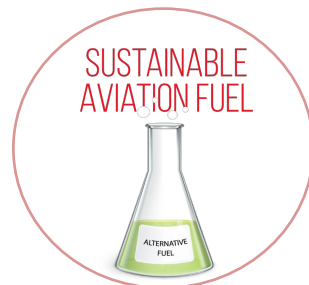




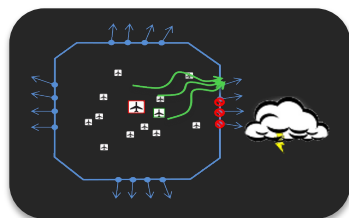
DIP-Enabled Services for Sustainability

Ground
Services

Flight Deck
Services



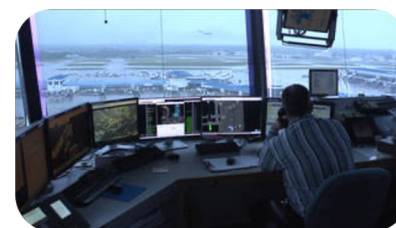
GLOBAL Aviation Industry's Goal:
*50% reduction in carbon emissions by 2050
relative to 2005 and possible net zero emissions
by 2060 through these three means*



**Collaborative Digital
Departure Reroute**
(SFNP-Ops-1, FY22-25)



**Sustainable Oceanic
Airborne Re-Routing**
(SFNP-Ops-2, FY26)



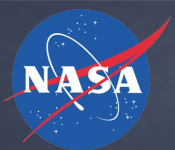
**Irregular Ops Recovery/
Disruption Management**
(SFNP-Ops-3, FY27)



4D Trajectory Optimization
(SFNP-Ops-4, FY28)

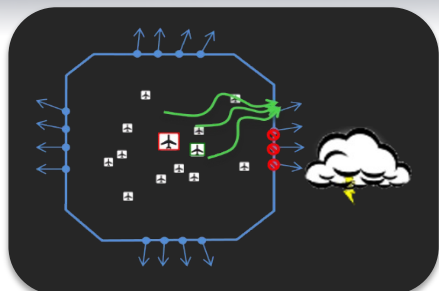
SFNP-Ops = Sustainable Flight National Partnerships - Operations

DIP Supports Sustainability Goals: Deliver reduction in emissions and optimize air operations through digital services



Collaborative Digital Departure Re-Routing (CDDR) for SFNP-Ops-1

Jeremy Coupe

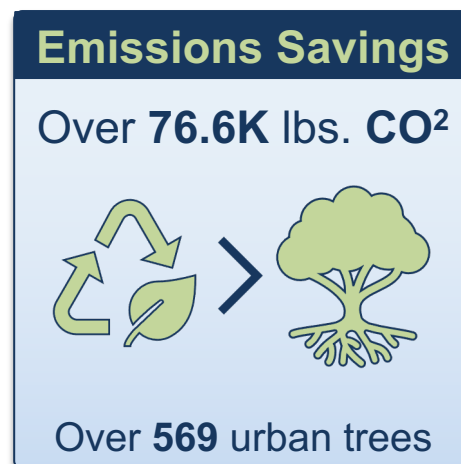


SFNP-Ops-1: Collaborative Digital Departure Re-Route (FY22 - 25)

Demonstrate CDDR via Trajectory Option Set (TOS) by rerouting flights and departures starting at NTX towards a high-density operational area

Benefits: Reduced fuel burn and emissions through reduced surface departure delay. Benefits rerouted flight as well as all departures

SFNP-Ops 1 system-wide aggregated savings (individually re-routed + other flights)
at D10 North Texas Metroplex (01 Jan 2022 – 16 Sep 2022)



1038 CANDIDATE flights ➡ 102 Airline Re-Route Requests ➡ 41 ATC-approved re-routes

DIP can scale these savings across the NAS; additional validation in FY24 in more complex airspace

Collaborative Digital Departure Re-Routing

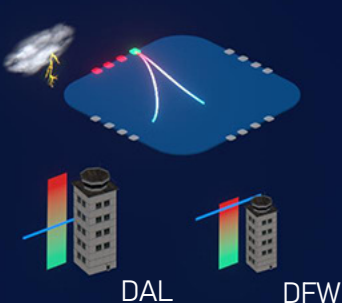
1 Preconfigure
TOS Parameters

Alternate Routes



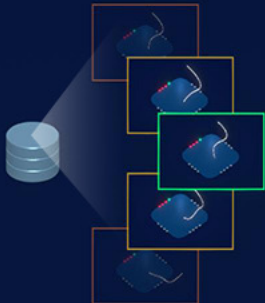
TOS database

2 Monitor
Demand & Capacity



*System continuously
assesses imbalance*

3 Present
Candidate TOS



Delay savings > Relative trajectory cost

4 Submit
TOS to ATC



all users notified

5 Evaluate
Post Operation



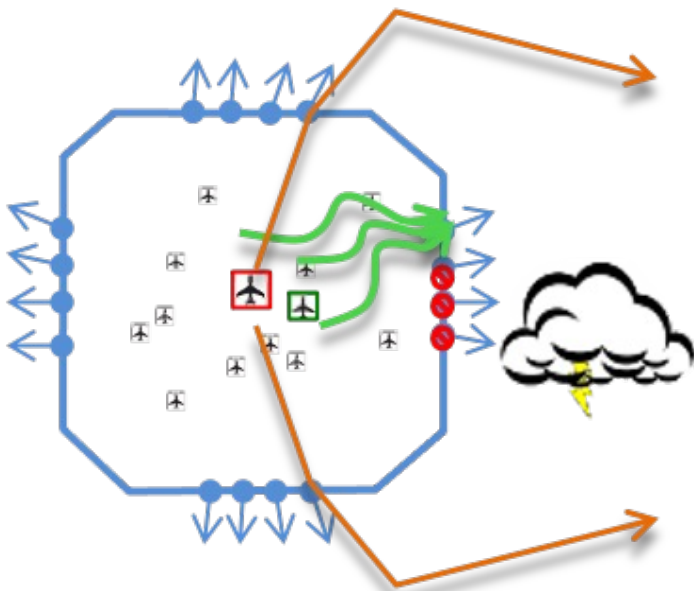
Benefits
Refinements
Lessons
Analyses
Reports

PROBLEM
Terminal airspace **demand/capacity imbalance** leads to **departure delays** on airport surfaces

Metroplex airports
with departure fixes

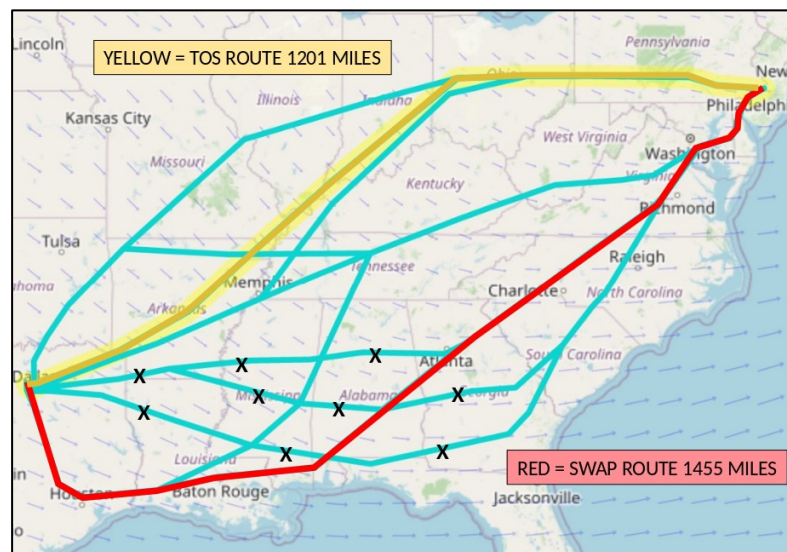
4

SOLUTION
CDDR system enables flight operators to **intelligently request reroutes** from the Air Traffic Control for **departure fix load balancing**



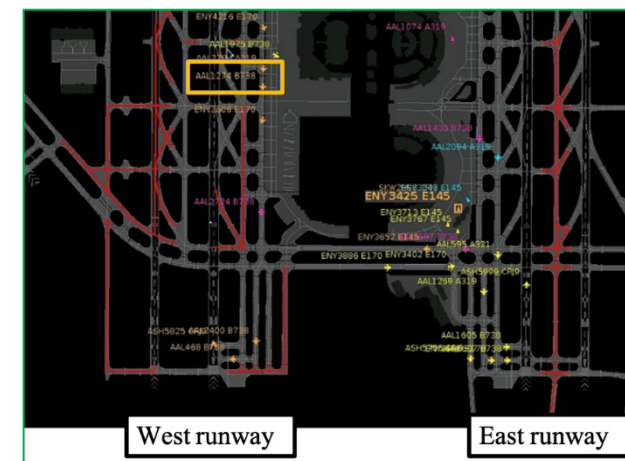
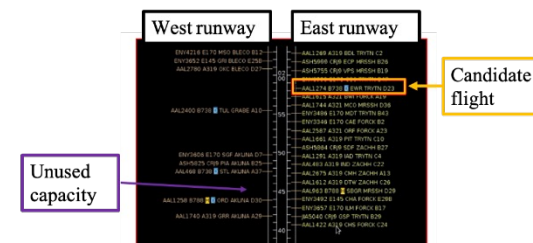
Traffic Management Initiative (TMI)

- Filed route is most direct route but subject to TMI
- Filed route remains through the original departure gate
- TOS route through adjacent departure gate and requires additional flight time
- TOS reroute reduces surface delay in exchange for increased flight time



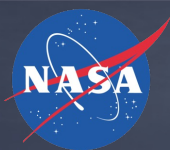
Recovery from SWAP

- Filed route is amended by ATC through an adjacent departure gate during a SWAP event
- SWAP event ends and TOS routes through the original Filed departure gate much shorter than SWAP route
- TOS reroute reduces surface delay and also has shorter flight time compared to SWAP route



Non-TMI Tactical Reroutes

- Often occurs when the parking gate is physically closer to the TOS runway than the Filed route runway
- Provides tactical opportunities to load balance runway demand to take advantage of unused capacity



CDDR User Interface in North TX (SFNP-Ops-1a)



Flight Operator - AAL Toolbar

TM Actions Create Show Window Taxi List Settings Search Clear

NEW 4... DAL STOP 2030-2200

Flight Operator - AAL Timeline Runway Arrival Departure

Arrival Runway Departure

2 BLECO OKC AAL1707
2 TYGGR SAF SKW3293
3 BLECO LGA AAL652
2 LOWGN BZN AAL2522
1 BLECO ICT AAL1865
BLECO OMA AAL2466
LOWGN PANC AAL521
BLECO EWR AAL2448

2 TYGGR LAX AAL969
5 NELYN SPJC AAL909
8 NELYN HRL SKW3252
9 ROO00 COU SKW3170
14 TYGGR LAS NKS380
13 ROO00 MSLP AVA441
12 ROO00 LBB AAL3324
8 TYGGR SFE AAL2554
7 TYGGR SFO AAL1175
7 PGLET SLC AAL1456
PGLET SLC DAL1389
6 RBBIT SAN AAL2516
5 PGLET PDX AAL2433
4 BLECO JFK AAL2292
3 BLECO MCI AAL1269
2 BLECO BIL ENY3559
2 JASPA SAT AAL1959
1 NELYN MMUN AAL2650
1 BLECO DSM ENY3770
RBBIT SNA AAL2100
2 LOWGN DEN AAL2652
2 NELYN LRD SKW3171
2 NELYN MFE ENY4193
1 BLECO LGA AAL2716

SKW4971 JAN THOR->TRCH 15M
ENY3923 BTR THOR->TRCH 15M
NKS202 BWI TRCH 15M
ENY3629 LFT THOR->TRCH 15M
AAL641 CMH AKUNA
AAL1829 TUL GRABE
AAL1484 CLE ZERLU->TRCH 15M
DCM8979 SHV THOR->TRCH 15
AAL2079 MEM HANUH->TRCH 15M
UAL1186 ORD AKUNA 3
AAL371 MSY THOR->TRCH 15M 5
UAL1890 IAH DARTZ 5
TAI441 MSLP DARTZ 11
SKW253H COU AKUNA 6
AAL2401 TPA THOR->TRCH 15M 2
AAL472 DCA TRCH 15M 5
DAL32 ATL TRCH 15M 4
AAL3413 CLL ARDIA 9
ENY3636 TYR THOR->TRCH 15M 4
SKW3284 MOB THOR->TRCH 15M 4
AAL646 MIA THOR->TRCH 15M 4
JZA978 CYZ AKUNA 4
ENY4237 XNA AKUNA 3
ASH5871 GPT THOR->TRCH 15M 2
AAL2011 TJSJ HANUH->TRCH 15M 2
AAL2334 PHL ZERLU->TRCH 15M 2
AAL2202 ORD AKUNA 3
SKW3167 EVV ZERLU->TRCH 15M 4
ASH5842 SDF ZERLU->TRCH 15M 4
ENY4008 TXK TRCH 15M 3
AAL1761 PIT AKUNA 2
ENY3752 SFE AKUNA 2

Flight Operator - AAL Map 3 : DFW

Flight Operator - AAL Map 1 : DFW

DIP CDDR Interface — Mozilla Firefox

DIP CDDR Interface

Updated: 22:20:44

Filter: ((Eligibility State = Candidate) AND (Coord State = Not Submitted) AND (Airline != ENY) AND (EOBT < Minutes 30)) OR (Has Scratch Pad is True)

Scratch Pad	Flight ID	Rwy	Dest	Route of Flight	Dep Gate	EOBT	ETOT	Top ETOT	Top CDR	Top RTC	Top Off Del Sav	Top Prob Del Sav > RTC	Top Agg AAL Fleet Del Sav	Flight Status	TMI Info	Eligibility State	Coord State	IN Delay	Top IN Del Sav
	SKW3167	17R	EVV	KDFW.ZACHH3.BSKAT..	EAST	22:10	22:45	22:28	DFWEVV1N		-16	67.0%	-65.7	Pushback	15M FixCld	Candidate	Not Submitted	+36	-10
	ASH5871	17R	GPT	KDFW.MRSSH2.ZALEA..	EAST	22:20	23:02	22:36	DFWGP11S		-26	72.3%	-69.4	Scheduled	15M FixCld	Candidate	Not Submitted	+52	-15
	AAL646	17R	MIA	KDFW.MRSSH2.ZALEA..	EAST	21:58	23:06	22:36	DFWMIA1S		-29	96.4%	-69.4	Scheduled	15M FixCld	Candidate	Not Submitted	+43	-30

Route Options Menu - AAL646

Route	CDR	Dep Gate	Rwy	Dist nm	Add nm	RTC	ETOT	OFF Del Sav	Agg Carrier Del Sav	Eligibility State	Coord State
KDFW.MRSSH2.ZALEA..SWB.MCB.J50.CEW.J..		EAST	17R	1063			23:06				
KDFW.DARTZ8.TNV.IAH.J86.LEV.Y290.GAW..	DFWMIA1S	SOUTH	17R	1056	-7		22:36	-29	-49.9	Candidate	Not Submitted
KDFW.AKUNA9.MLC.RZC.ARG.MERON.DER..	DFWMIA1N	NORTH	17R	1320	+257		22:36	-29	-49.9	Potential	Not Submitted

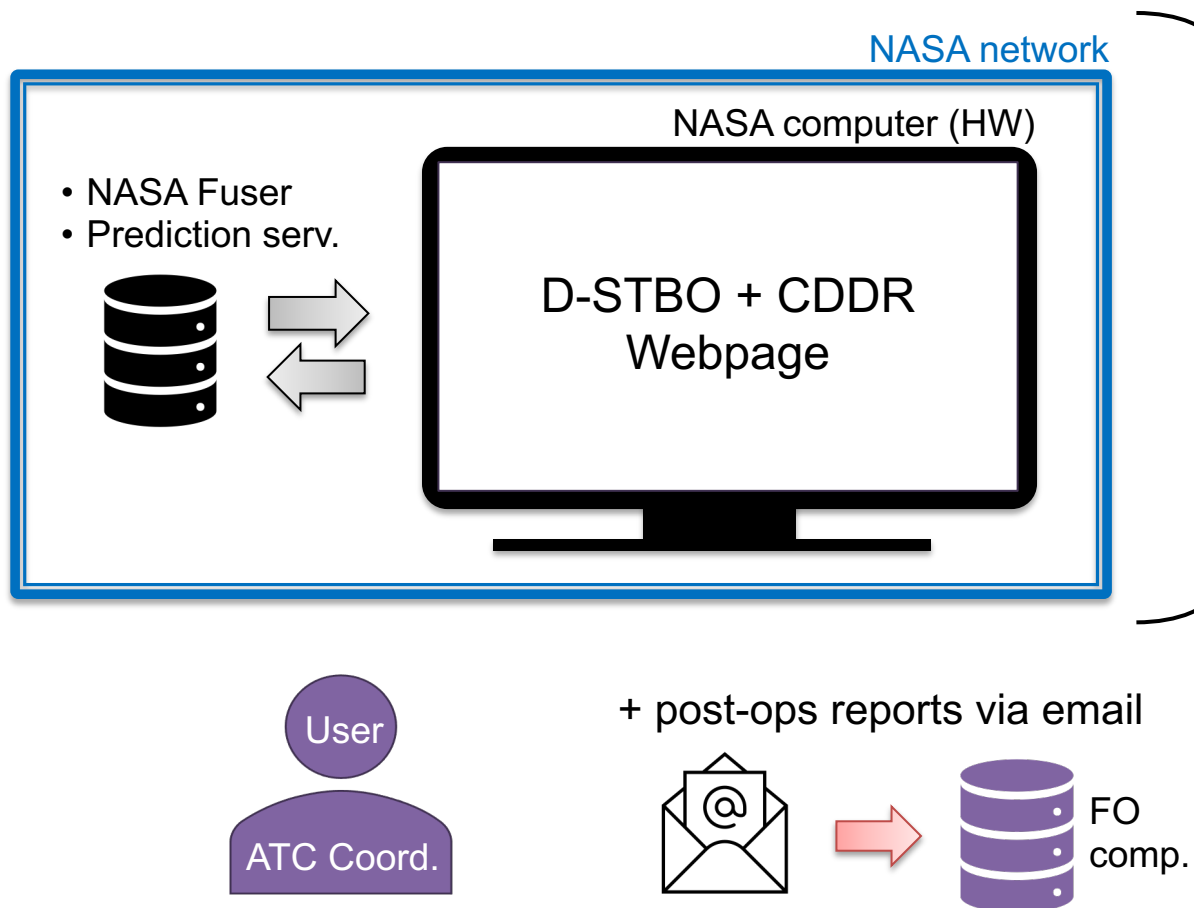
SKW3284 17R MOB KDFW.MRSSH2.ZALEA.. EAST 22:19 23:09 22:36 DFWMOB1S +27 77.6% -69.4 Scheduled 15M FixCld Candidate Not Submitted +18 -19

AAL2401 17R TPA KDFW.MRSSH2.ZALEA.. EAST 22:26 23:23 22:40 DFWTPA1S +28 90.2% -69.4 Scheduled 15M FixCld Candidate Not Submitted +35 -29

SKW4971 17R JAN KDFW.MRSSH2.MRSSH.. EAST 22:47 23:54 23:03 DFWJAN1S +46 66.4% -56.6 Scheduled 15M FixCld Candidate Not Submitted +43 -26

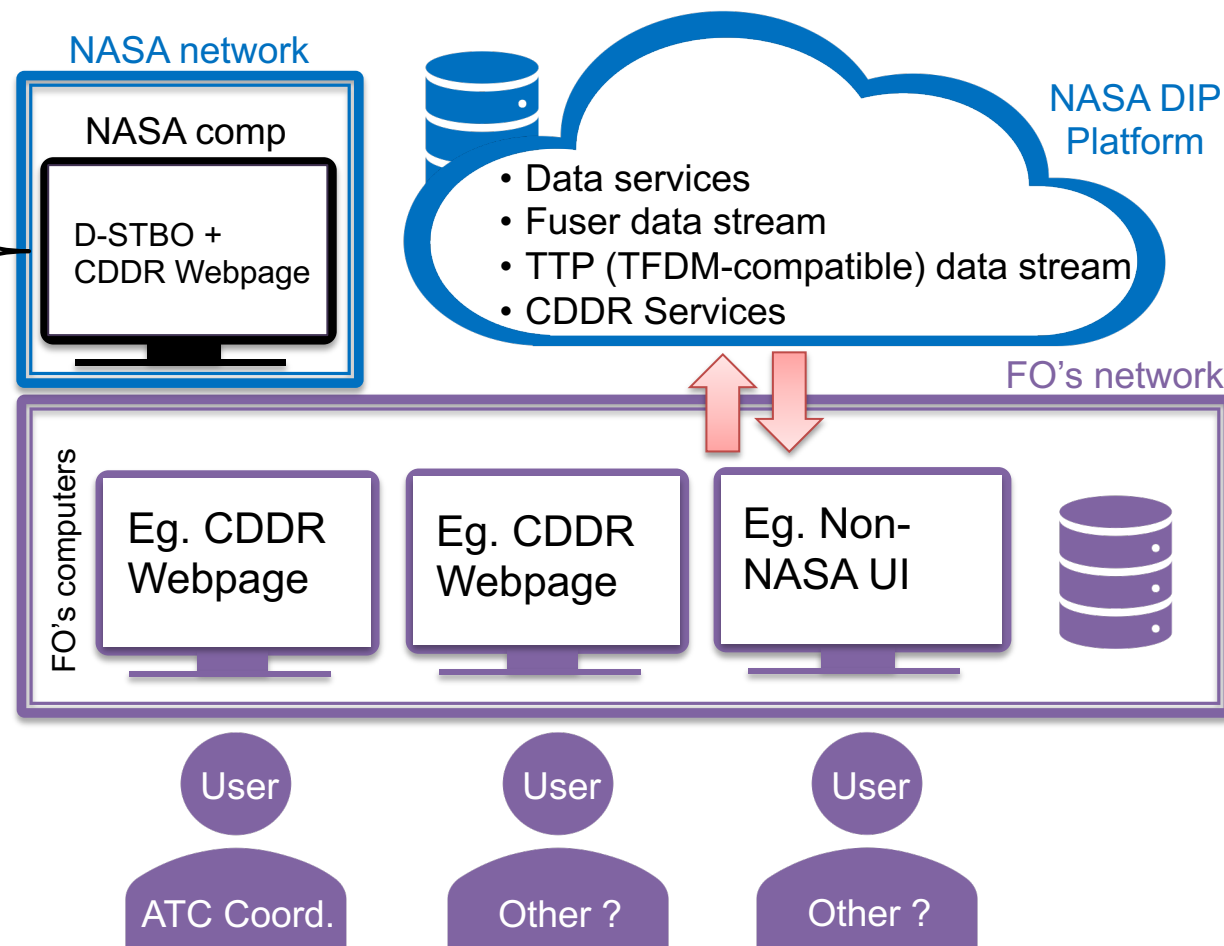
Front End User Experience is Unimpacted; Targeting first piece to Tech Transfer

In FY22



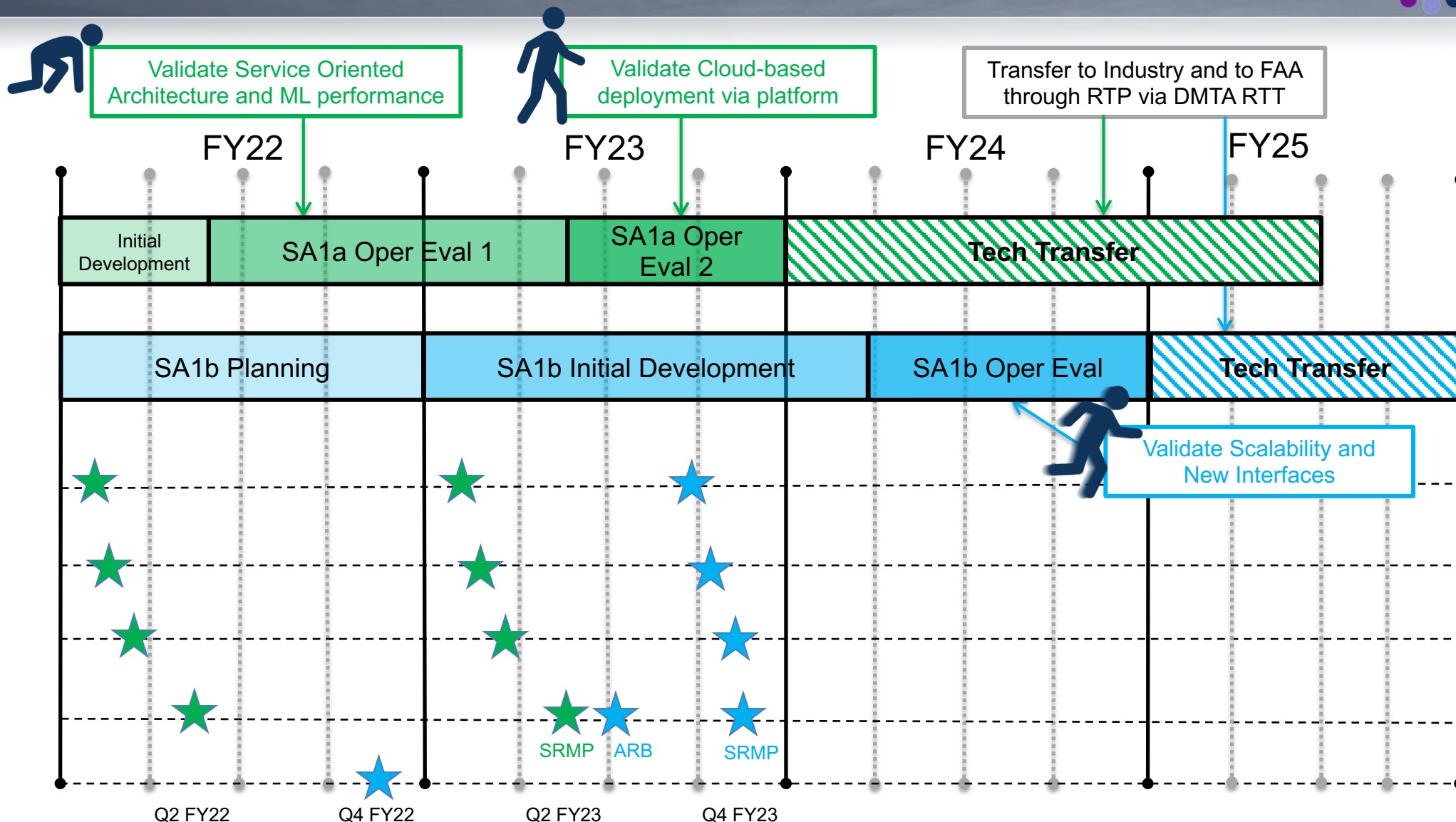
Access to data, services and interface *is limited to* a NASA computer behind a firewall

Starting in FY23 and beyond



Access to data, services and interface *is available* from the cloud

SNFP-Ops-1 Progress and Milestones



SNFP-Ops-1a North Texas Milestones in Green

SNFP-Ops-1b Complex Airspace Milestones in Blue